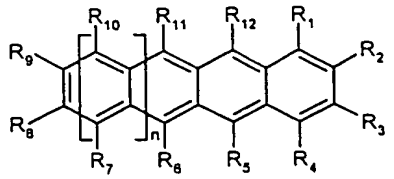
Claims

1. An organic semiconducting layer formulation, which comprises:
an organic binder which has a permittivity, ε, at 1,000 Hz of 3.3 or less; and
a polyacene compound of Formula A:



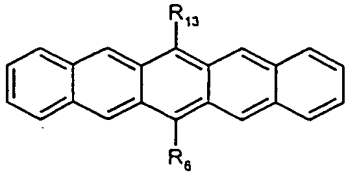
Formula A

wherein:
each of R_1, R_2, R_3, R_4, R_5, R_6, R_7, R_8, R_9, R_{10}, R_{11} and R_{12}, which may be the same or different, independently represents hydrogen; an optionally substituted C_1-C_{40} carbyl or hydrocarbyl group; an optionally substituted C_1-C_{40} alkoxy group; an optionally substituted C_6-C_{40} aryloxy group; an optionally substituted C_7-C_{40} alkylaryloxy group; an optionally substituted C_2-C_{40} alkoxycarbonyl group; an optionally substituted C_7-C_{40} aryloxycarbonyl group; a cyano group (-CN); a carbamoyl group (-C(=O)NH_2); a haloformyl group (-C(=O)-X, wherein X represents a halogen atom); a formyl group (-C(=O)-H); an isocyano group; an isocyanate group; a thiocyanate group or a thioisocyanate group; an optionally substituted amino group; a hydroxy group; a nitro group; a CF_3 group; a halo group (Cl, Br, F); or an optionally substituted silyl group; and
wherein independently each pair of R_2 and R_3 and/or R_8 and R_9, may be cross-bridged to form a C_4-C_{40} saturated or unsaturated ring, which saturated or unsaturated ring may be intervened by an oxygen atom, a sulphur atom or a group shown by formula -N(R_a)- (wherein R_a is a hydrogen atom or an optionally substituted hydrocarbon group), or may optionally be substituted; and
wherein one or more of the carbon atoms of the polyacene skeleton may optionally be substituted by a heteroatom selected from N, P, As, O, S, Se and Te; and
wherein independently any two or more of the substituents R_1-R_{12} which are located on adjacent ring positions of the polyacene may, together, optionally constitute a further C_4-C_{40} saturated or unsaturated ring optionally interrupted by O, S or -N(R_a) where R_a is as defined above) or an aromatic ring system, fused to the polyacene; and wherein
n is 0, 1, 2, 3 or 4.

2. An organic semiconducting layer formulation as claimed in claim 1 wherein the

polyacene compound is selected from Compound Groups 1 or 8 or isomers thereof wherein:

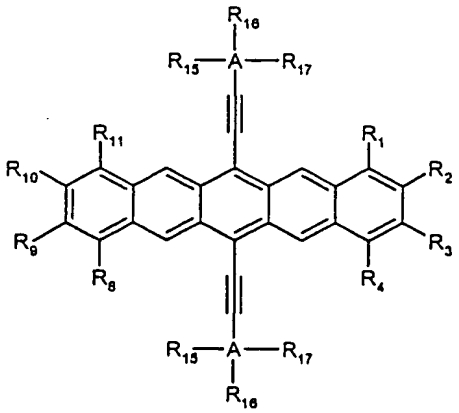
compound Group 1 is represented by Formula 1:



Formula 1

and

compound Group 8 is represented by Formula 8:



Formula 8

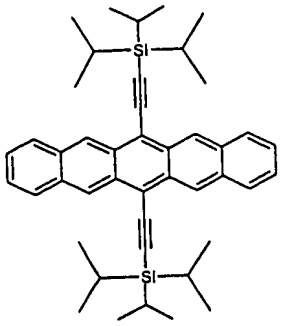
wherein, R_6 and R_{13} in Group 1 and R_1, R_2, R_3, R_4, R_8, R_9, R_{10}, R_{11}, R_{15}, R_{16}, R_{17} and R_{18}, in Group 8 are each independently the same or different and each independently represents: H; an optionally substituted C_1-C_{40} carbyl or hydrocarbyl group; an optionally substituted C_1-C_{40} alkoxy group; an optionally substituted C_6-C_{40} aryloxy group; an optionally substituted C_7-C_{40} alkylaryloxy group; an optionally substituted C_2-C_{40} alkoxycarbonyl group; an optionally substituted C_7-C_{40} aryloxycarbonyl group; a cyano group (-CN); a carbamoyl group (-C(=O)NH_2); a haloformyl group (-C(=O)-X, wherein X represents a halogen atom); a formyl group (-C(=O)-H); an isocyano group; an isocyanate group; a thiocyanate group or a thioisocyanate group; an optionally substituted amino group; a hydroxy group; a nitro group; a CF_3 group; a halo group (Cl, Br, F); or an optionally substituted silyl group; and wherein independently each pair of R_1 and R_2, R_2 and R_3, R_3 and R_4, R_8 and R_9, R_9 and R_{10}, R_{10} and R_{11}, R_{15} and R_{16} and R_{16} and R_{17} may be cross-bridged with each other to form a C_4-C_{40} saturated or unsaturated ring, which saturated or unsaturated ring may be intervened by an oxygen atom, a sulphur atom or a group shown by formula: -N(R_a)- (wherein R_a is a hydrogen atom or a hydrocarbon group), or may optionally be substituted; and wherein A represents Silicon or Germanium.

3. An organic semiconducting layer formulation as claimed in claim 1 or 2 wherein n is 0 or 2.

4. An organic semiconducting layer formulation as claimed in claim 3 wherein n is 2.

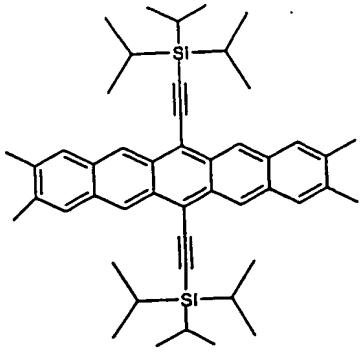
5. An organic semiconducting layer formulation as claimed in any of the preceding claims wherein the optionally substituted C_1-C_{40} hydrocarbyl group is a saturated or unsaturated acyclic group, or a saturated or unsaturated cyclic group.

6. An organic semiconducting layer formulation as claimed in any of preceding claims 1 to 5 wherein the polyacene compound is 6, 13-bis(triisopropylsilylethynyl)pentacene of Formula 1,



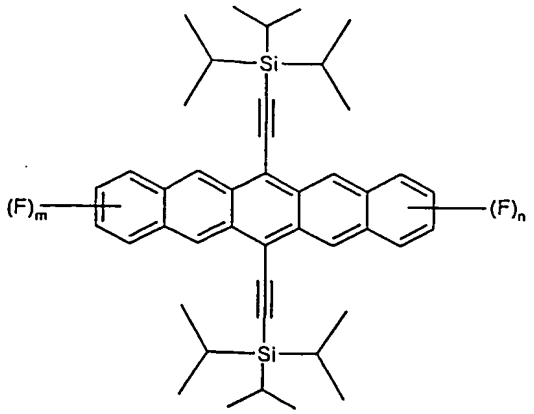
Formula 1

7. An organic semiconducting layer formulation as claimed in any of preceding claims 1 to 5 wherein the polyacene compound is 2,3,9,10-tetramethyl,6,13-bis (triisopropylsilylethynyl)pentacene of Formula 2:



Formula 2

8. An organic semiconducting layer formulation as claimed in any of preceding 1 to 5 wherein the polyacene compound of Formula 3:



Formula 3

wherein n and m is each independently 0,1, 2, 3 or 4, more preferably 0,1 or 2;

9. An organic semiconducting layer formulation as claimed in any of the preceding claims wherein the organic binder resin has a permittivity at 1,000 Hz of less than 3.0, preferably 2.9 or less.

10. An organic semiconducting layer formulation as claimed in claim 10 wherein the organic binder resin has a permittivity at 1,000 Hz greater than 1.7, especially a permittivity from 2.0 to 2.9.

11. An organic semiconducting layer formulation as claimed in any one preceding claim wherein the organic binder resin is an insulating binder.

12. An organic semiconducting layer formulation as claimed in claim 11 wherein the insulating binder is selected from poly(α-methylstyrene), polyvinylcinnamate, poly(4-vinylbiphenyl), poly(4-methylstyrene) and Topas™ 8007, more preferably poly(α-methylstyrene), polyvinylcinnamate and poly(4-vinylbiphenyl).

13. An organic semiconducting layer formulation as claimed in any of claims 1 to 10 wherein the organic binder resin is a semiconductor binder.

14. An organic semiconducting layer formulation as claimed in claim 13 wherein the semiconductor binder comprises a number average molecular weight (M_n) of at least 1500-2000, more preferably at least 3000, even more preferably at least 4000 and most preferably at least 5000.

15. An organic semiconducting layer formulation as claimed in claims 13 or 14 wherein the semiconductor binder is selected from poly(9-vinylcarbazole) or PTAA1.

16. An organic semiconducting layer formulation as claimed in any of the preceding claims wherein the formulation further comprises a solvent.

17. An organic semiconducting layer formulation as claimed in any of the preceding claims wherein the solvent is selected from xylene(s), toluene, tetralin and o-dichlorobenzene.

18. An organic semiconducting layer formulation as claimed in any of the preceding claims wherein the ratio of polyacence compound to binder is 20:1 to 1:20 by weight, preferably 10:1 to 1:10 more preferably 5:1 to 1:5, still more preferably 3:1 to 1:3 further preferably 2:1 to 1:2 and especially 1:1.

19. An organic semiconducting layer formulation as claimed in any of the preceding claims which comprises a solids content of 0.1 to 10% more preferably 0.5 to 5% by weight.

20. A process for preparing an organic semiconducting layer formulation as claimed in any of the preceding claims which comprises: (i) depositing on a substrate a liquid layer of a mixture which comprises the polyacene compound, the organic binder resin or precursor thereof and optionally a solvent, and (ii) forming from the liquid layer a solid layer which is the organic semiconducting layer.

21. An electronic device comprising an organic semiconducting layer formulation as claimed in any of preceding claims 1 to 19.

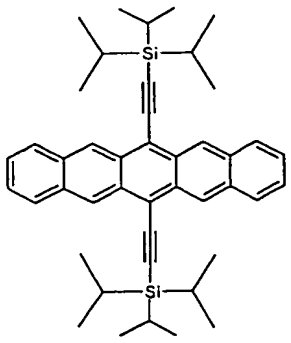
22. An electronic device according to claim 21 which comprises a field effect transistor (FET), organic light emitting diode (OLED), photodetector, chemical detector, photovoltaic cell (PVs), capacitor sensor, logic circuit, display or memory device.

23. An OFET device comprising an organic semiconducting layer formulation wherein the organic semiconducting layer formulation comprises:

a compound of Formula 1;

a binder; and

a solvent,



Formula 1

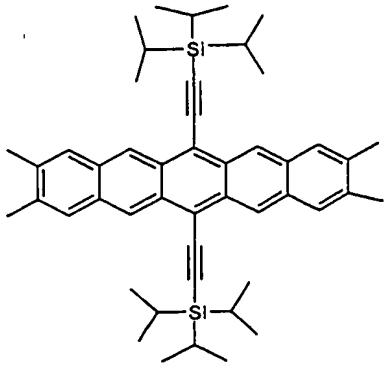
wherein the binder is selected from poly(α-methylstyrene), Topas™ 8007, poly(4-methylstyrene), polystyrene and polystyrene-co-α-methylstyrene, most preferably poly(α-methylstyrene); and the solvent is selected from toluene, ethylcyclohexane, anisole and p-xylene; most preferably toluene.

24. An OFET device comprising an organic semiconducting layer formulation wherein the organic semiconducting layer formulation comprises:

a compound of Formula 2;

a binder; and

a solvent,



Formula 2

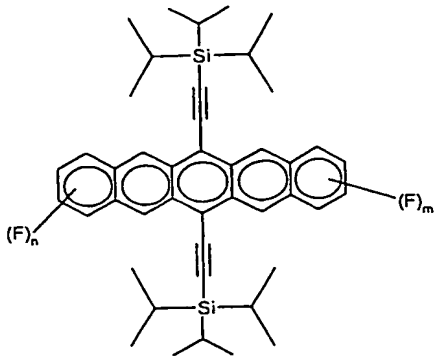
wherein the binder is selected from poly(α-methylstyrene), polyvinylcinnamate, and poly(4-vinylbiphenyl), most preferably poly(α-methylstyrene); and the solvent is 1,2-dichlorobenzene.

25. An OFET device comprising an organic semiconducting layer formulation wherein the organic semiconducting layer comprises:

a compound of Formula 3;

a binder; and

a solvent,



Formula (3)

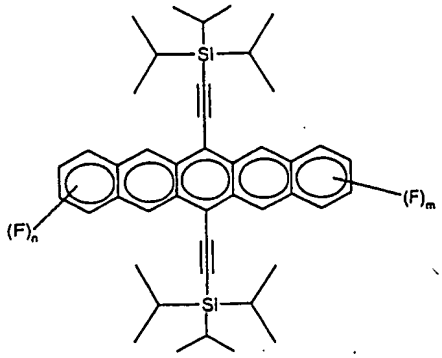
wherein :

n and m are each independently 0,1, 2, 3 or 4, more preferably 0,1 or 2; and

the binder is poly(α-methylstyrene); and

the solvent is toluene.

26. A compound of Formula 3



wherein n and m are each independently 1 or 3, more preferably 1.